LabVIEW as a Common Language

Resolving the Community-Building : Skill-Embedded Tension in Taught Master's Learning

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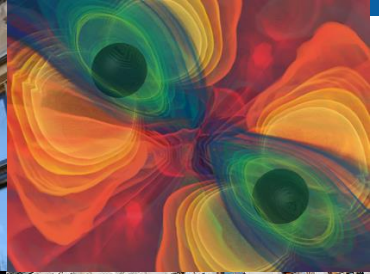
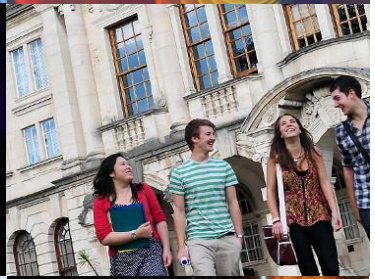
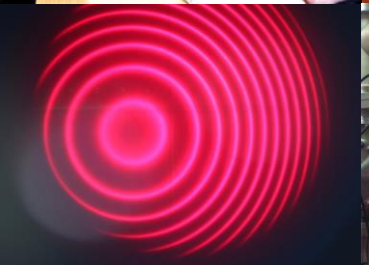
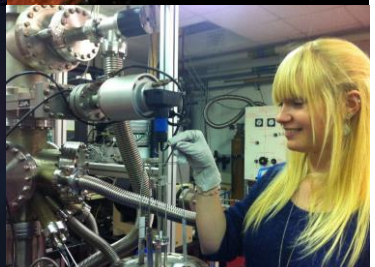
MSc Teaching Philosophy and Design



MSc courses at PHYSX: a brief history

- **2005**: MSc Biophotonics (ended 2015)

- **2015**: MSc Physics
- **2015**: MSc Astrophysics

- **2017**: MSc Compound Semiconductor Physics
- **2017**: MSc Data-Intensive Physics
- **2017**: MSc Data-Intensive Astrophysics

- **2018**: New MSc (TBA)
- **2019**: New MSc (TBA)

What is an MSc for?

Where do our students want do go?

- Academia
- Industry
- Other (teaching, journalism, etc)

How does an MSc get them there?

- Development
- Conversion
- Other (CPD, career change, etc)

What does a “typical” MSc student look like?

- Second-class BSc, aiming for a PhD
- Little or no experience outside of university

Conflicting demands?

What do supervisors want?

Practical and research skills

What must PhD students do?

Engagement and community

NATIONAL INSTRUMENTS

A community-building : skill-embedding tension

Practical and research skills

- What the student must **do**
- Emphasis on the **individual**

Engagement and community

- What the student must **be**
- Emphasis on the **group**

Resolving the tension: student identity and ownership

1. Provide a dedicated space: **environment**
2. Unify the students' sense of purpose: **ethos**
3. Develop the skills: **core modules**


Conference / study room


Teaching laboratory

Providing the **environment**: dedicated MSc teaching facilities

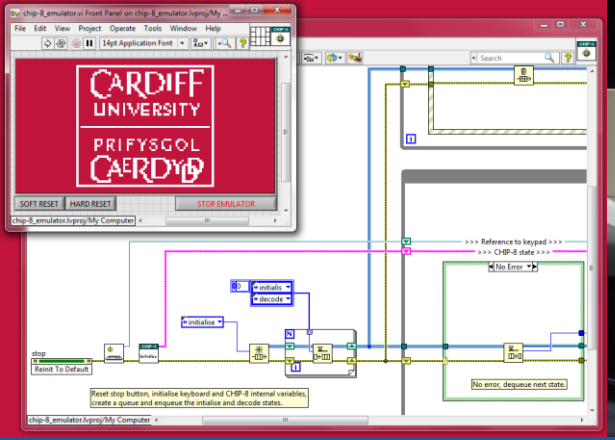
- Learning in the round
- Guaranteed student access
- Student ownership of space
- Daily staff contact

NATIONAL INSTRUMENTS

The research group **ethos**: a unifying sense of purpose

- Engagement through partnership
- Student ownership of learning
- Peer support and accountability
- Collaborative learning

NATIONAL INSTRUMENTS



Developing skills: unique **core modules** (MSc Physics)

- Autumn semester: student-lead microprojects, LabVIEW core
- Spring semester: research and study skills, advanced LabVIEW elective

- Collaborative learning: **community building**
- Problem-based learning: **embedding skills**
- Student ownership of learning: **engagement through partnership**

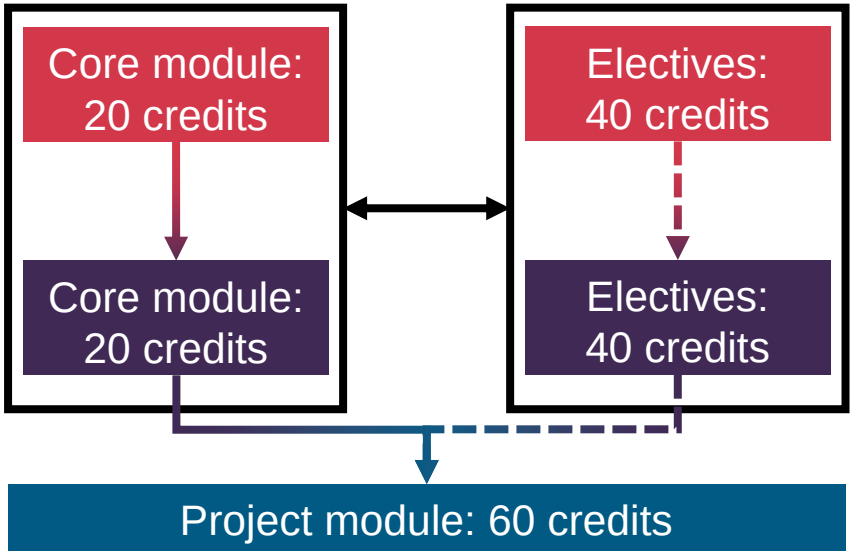
NATIONAL INSTRUMENTS

Top-level MSc design: tapering towards independence

- Core: community, skills, LabVIEW
- Electives: research-lead teaching

- Direct scaffolding of core modules to summer research project

- Degree of instructor-lead material **tapers off** throughout core modules



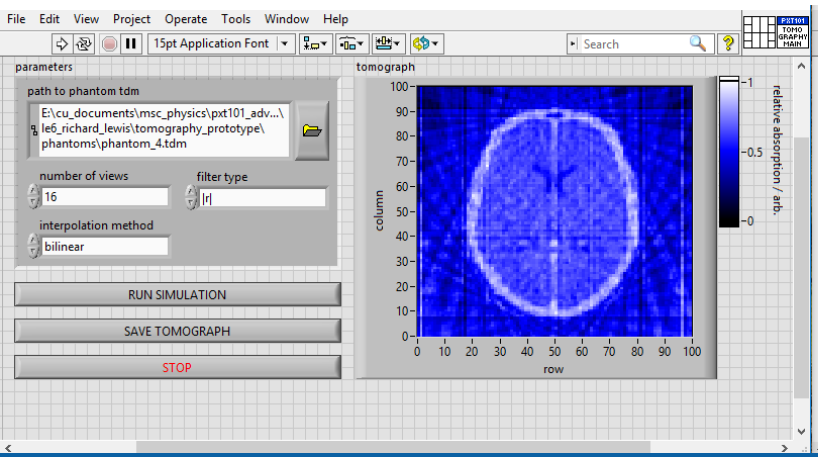
MSc student feedback

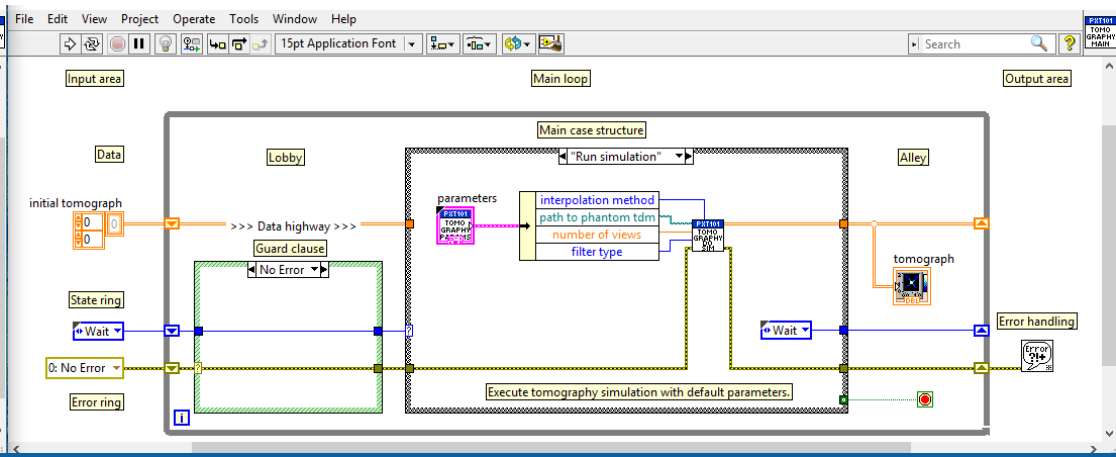
“The MSc core modules were easily the best and what I learned the most in. Having our own floor really enhanced the community feel.”

“I really enjoyed how close the cohort has become - spending so much time around each other definitely creates a support network which is helpful.”

“I enjoyed the independent work aspect and the fact that the module used a real-world approach on how physics research is conducted. It was enjoyable and the teaching was first rate.”

LabVIEW as a Common Language





Why teach LabVIEW? Why not Python or something else?

- Immediately useful with Express VIs and NI hardware
- Shallow initial learning curve: can get to GUI-driven applications easily
- Rapid development allows more time for concepts

- It's weird (in a good way): levels the field, acts as a point of reference

NATIONAL INSTRUMENTS

PXT101 “Advanced Experimental Techniques in Physics”

Introduction to LabVIEW

- Problem-based learning
- Hands-on activities weekly
- Focus on using LabVIEW practically
- Strong emphasis on good style
- Software development best practices

Student-lead micro-projects

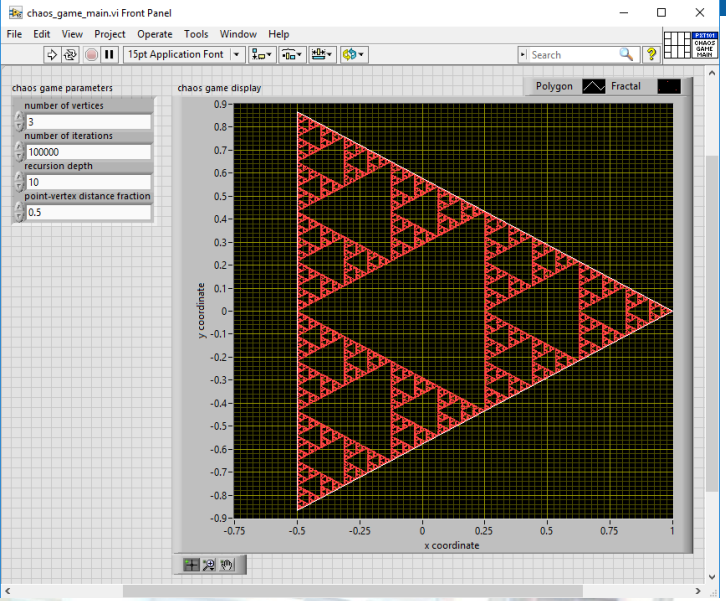
- Complete student ownership
- Objectives negotiated
- Weekly group meetings
- Weekly lab diary submissions
- Final report and presentations

From “hello world!” to GUI-focussed queue-based state machines and laboratory automation in 10 weeks

Mandatory LabVIEW aspect, developed in the latter half of the semester.

(Approximately CLAD standard)

NATIONAL INSTRUMENTS



Exercise example: *Chaos Game*

Context

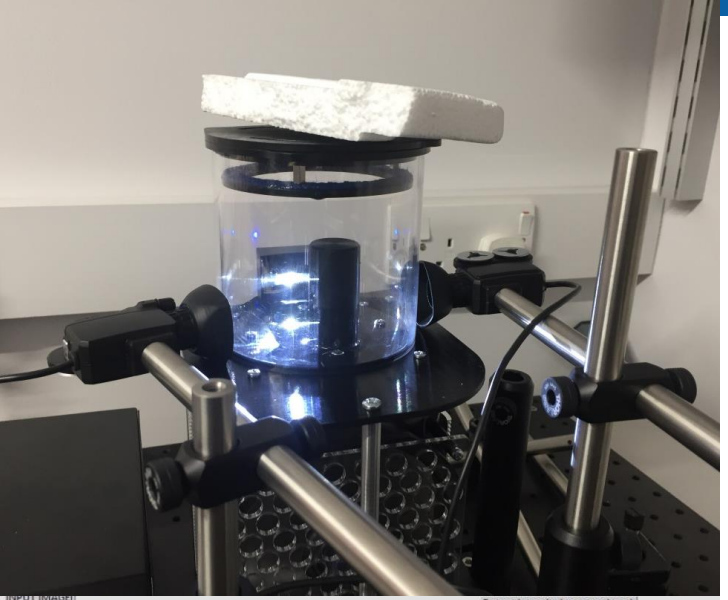
- Group assignment over weeks 5 and 6
- Course consolidation point

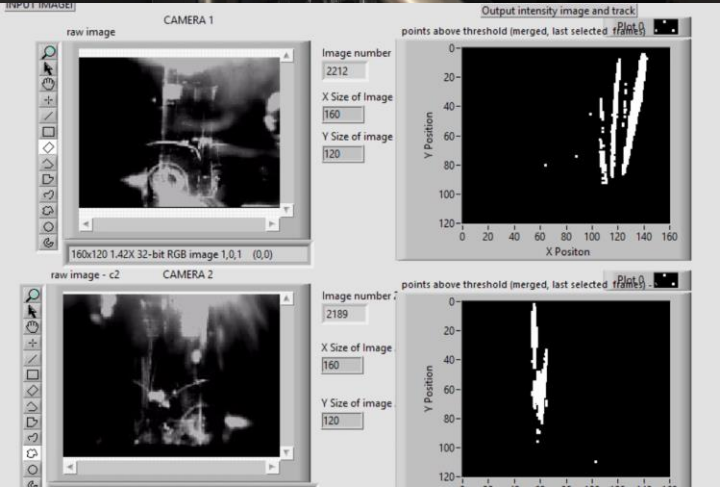
Aims

- Generate functional specification of application
- Assign tasks, develop as a group, bug-fix
- Deliver application on-specification and on time

Outcomes

- All groups returned working code
- One group avoided a bug in my example code!





Micro-project example: *Cloud Chambers*

Context

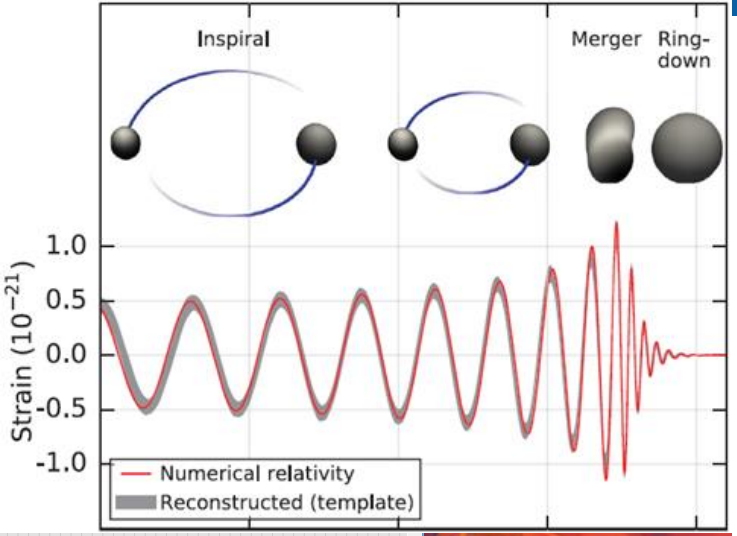
- Compact demonstration devices
- Part of £93k *Quarknet Cymru* NSA grant
- Students have zero LabVIEW at project start

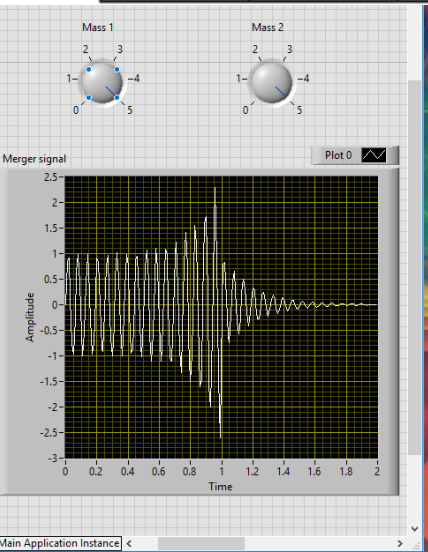
Aims

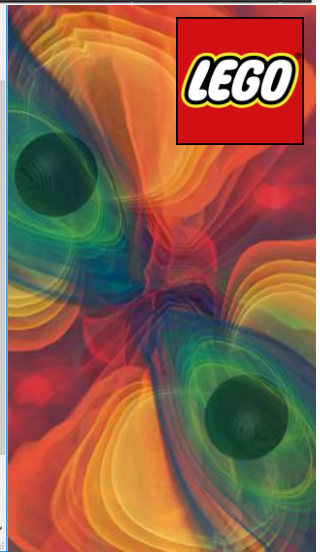
- Upgrade cloud chambers with cameras
- Maximise visibility of tracks
- Use LabVIEW to recreate tracks in 3D

Outcomes

- Automatic track extraction (2 cameras)
- Initial work on 3D track recreation (3 cameras)







Micro-project example: *LEGO-LIGO*

Context

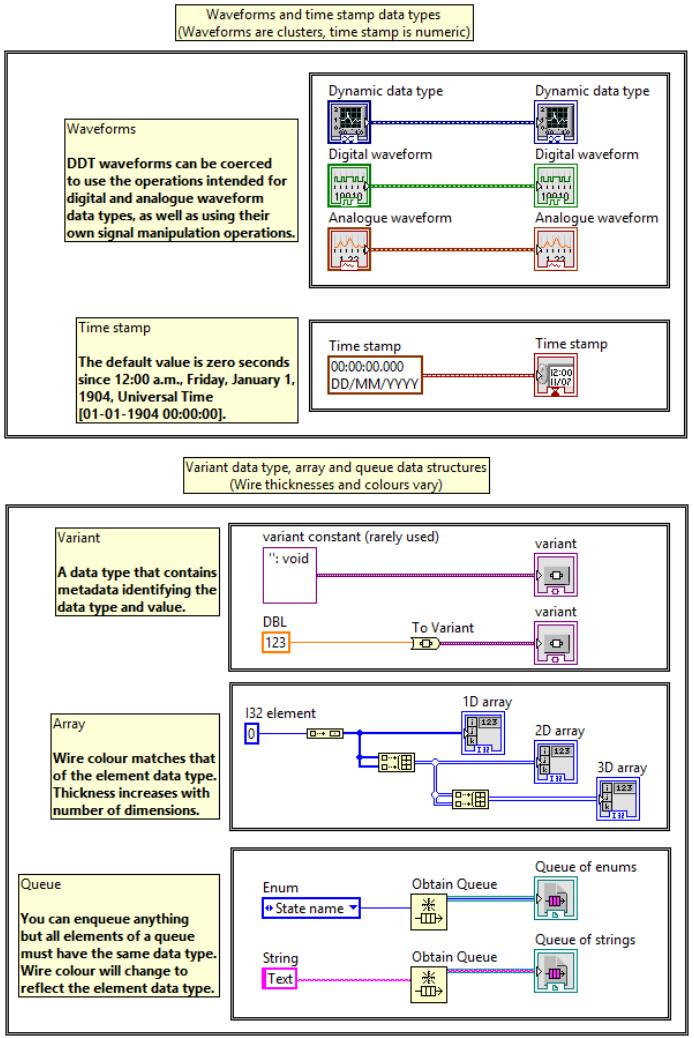
- £3.8k STFC Public Engagement Small Award
- Recreate LIGO in LEGO for outreach(!)

Aims

- Create mechatronic LEGO diorama of LIGO
- Demonstrate proof-of-principle

Outcomes

- Diorama essentials constructed
- Working mechatronics and GUI
- “Toy” waveforms used for proof-of-concept



LabVIEW as a common language?

Promotes collaborative learning

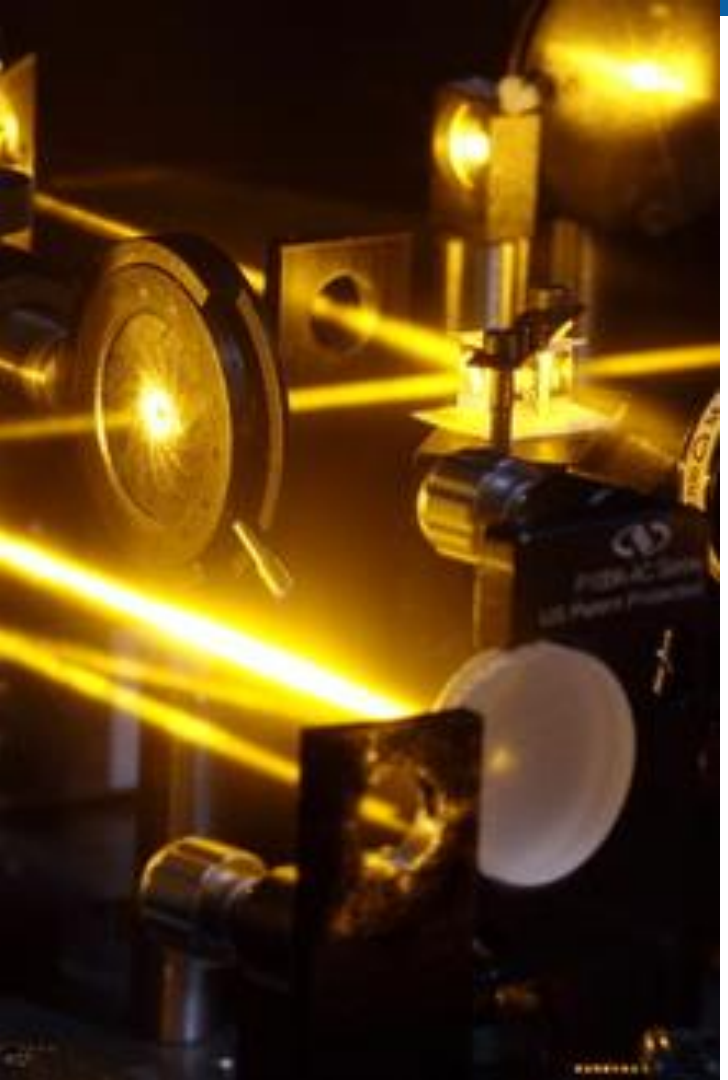
- Bug-fixing in group meetings promotes sharing of hints, tips and best practice
- Graphical nature more intuitive; easier to grasp the gist of (well-written) code

Rapidly accessible, solves real problems

- From about week 5, students can be told “code it in LabVIEW and find out”

Weird in a good way :)

- Requires a certain type of lateral thinking
- Students often sketch G code on the board, even when discussing other languages!



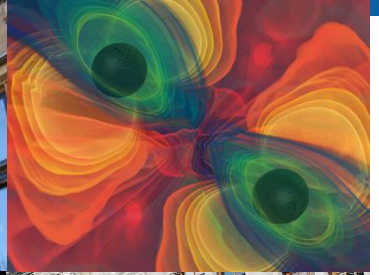
MSc student feedback

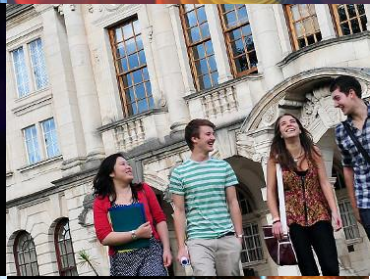
“The way the LabVIEW language was explained definitely improved the total progress I made”

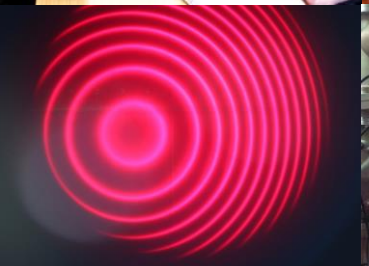
“Excellent quality teaching supported by good module resources. Good hands-on programming experience.”

“The coding aspects of the MSc have been insanely useful for my new job.”

“[LabVIEW] has proved extremely useful throughout my MSc course”




Summary

- Unique approach to MSc teaching
- Embeds skills and builds a PGT community
- Bridges culture between UG and PGR
- Does not compromise quality or thoroughness

Read the NI EIA award-winning case study:
http://sine.ni.com/cs/app/doc/p/id/cs-17230

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